United States General Accounting Office

GAO

Report to Congressional Requesters

December 1994

NUCLEAR NONPROLIFERATION

U.S. International Nuclear Materials Tracking Capabilities Are Limited

GAO/RCED/AIMD-95-5

Accession Number: 5577

Publication Date: Dec 01, 1994

Title: Nuclear Nonproliferation: US International Nuclear Materials Tracking Capabilities Are Limited

Personal Author: Wells, J.; Aloise, G.; Charlifue, J.C. et al.

Corporate Author Or Publisher: U.S. General Accounting Office, GAO, Washington, DC 20548 Report Number: GAO/RCED/AIMD-95-5

Comments on Document: Report to Congressional Requesters

Descriptors, Keywords: Nuclear Nonproliferation US International Material Tracking Capability NMMSS DoE IAEA Export Process Bilateral Physical Protection Visit

Pages: 00027

Cataloged Date: Mar 28, 1995

Document Type: HC

Number of Copies In Library: 000001

Record ID: 29782

GAO

United States
General Accounting Office
Washington, D.C. 20548

B-259533

December 27, 1994

The Honorable Charles E. Schumer
House of Representatives

The Honorable John Glenn
Chairman, Committee on Governmental
Affairs
United States Senate

This report responds to your request for information on how the United States tracks its exported civilian (nondefense-use) nuclear materials and ensures their physical protection. Specifically, this report (1) describes the capability of the Department of Energy's (DOE) computerized Nuclear Materials Management and Safeguards System (NMMSS) to track the international movement of nuclear materials, (2) assesses the adequacy of DOE's planned new NMMSS, and (3) provides information on how the United States ensures the physical protection of nuclear materials of U.S. origin that are exported.

Results in Brief

The United States relies primarily on the NMMSS to track the nuclear materials exported to foreign countries. However, this system does not have all the information needed to track the specific current location (facility) and status of all nuclear materials of U.S. origin that are supplied to foreign countries. For example, the system does not track exported U.S. nuclear materials that are moved from facility to facility within countries, nor does it show the current status of the nuclear materials (e.g., irradiated, unirradiated, fabricated, burned up, or reprocessed). Thus, the NMMSS may not contain correct data on where (at which facility) these materials are located within foreign countries or on their current status. The system does not contain this information primarily because the amounts, types, and reliability of data contained in the NMMSS depend largely on the data required to be reported under international agreements for peaceful nuclear cooperation, as well as on foreign countries' and U.S. and foreign facilities' willingness to report complete and accurate data.

Since the NMMSS is an older mainframe-based system, DOE decided to modernize it using PC technology. However, since DOE's new NMMSS will replicate the current NMMSS' functions, the new system will contain the same tracking limitations that existed previously. Thus, the data contained in the new NMMSS on the location and status of U.S.-supplied nuclear materials internationally will continue to be limited by the data reported

under the agreements for cooperation. Moreover, DOE did not adequately plan the development effort for the new NMMSS. In planning the new system, DOE did not follow sound systems development practices. Furthermore, DOE did not identify and define the users' needs or adequately explore design alternatives that would best achieve these needs in the most economic fashion. Therefore, DOE cannot ensure that it chose the most cost- effective alternative or developed a system that will meet users' needs.

Neither DOE's current nor planned new nuclear materials tracking system was intended to provide or contain data on nuclear materials of foreign origin that were never imported into the United States. Accordingly, DOE and other agencies collect information on the status of U.S. and non-U.S. nuclear materials worldwide through other sources. However, these sources are limited in their ability to obtain accurate data in certain countries.

The U.S. government's ability to ensure that exported nuclear materials are adequately protected is limited because that ability is contingent on foreign countries' cooperation. Many members of the international community, including the United States, believe that the physical protection of nuclear materials is the responsibility of the individual country. Therefore, the United States must rely on the individual country's commitment to comply with voluntary international guidelines for physical protection. While the United States conducts on-site physical protection evaluations of facilities in countries with U.S.-supplied nuclear materials, recommendations that may result from these visits are not binding on the country.

Background

Hundreds of tons of plutonium and highly enriched uranium (HEU) have accumulated worldwide, and inventories of plutonium are expected to continue to grow in years to come as a result of reprocessing[1] or recovering activities. Tracking and accounting for these and other nuclear materials are important in order to (1) ensure that nuclear materials are used only for peaceful purposes; (2) help protect nuclear materials from loss, theft, or other diversion; (3) comply with international treaty obligations; and (4) provide data to policymakers and other government officials.

[1]Reprocessing is the chemical separation of usable uranium and plutonium from spent nuclear reactor fuel.

The United States regulates and controls its exports of civilian-use nuclear materials through three mechanisms—agreements for cooperation, export licenses, and subsequent arrangements. Subsequent arrangements refer to the regulatory controls over certain cooperative arrangements for the supply, use, or retransfer[2] of nuclear materials. Certain controls in the agreements for cooperation are designed to assure both the United States and the recipient nation or group of nations that materials transferred between parties will be used for authorized purposes only and will be properly safeguarded. (See app. I for a discussion of U.S. export license processes.) As of November 1994, the United States had 29 agreements for cooperation with other countries.

In addition, the United States, as well as many members of the international community, relies on the International Atomic Energy Agency (IAEA) to develop and enforce effective international safeguards—technical measures designed to detect the diversion of significant quantities of nuclear materials from peaceful uses—for nuclear materials of U.S. and non-U.S. origin.

The U.S. agreement with IAEA, as well as some of the U.S. agreements for cooperation, requires the United States to maintain a system of accounting and control over source and special nuclear materials.[3] In addition, the United States reports data to IAEA on nuclear materials imported by and exported from the United States. DOE's automated tracking system, the NMMSS, is used to fulfill these accounting, controlling, and reporting obligations for U.S.-supplied international nuclear materials. DOE and the Nuclear Regulatory Commission (NRC) cosponsor the NMMSS, and it is managed and operated by a DOE contractor—Martin Marietta Energy Systems, Incorporated.

The NMMSS has been used to account for U.S. imports and exports of nuclear materials since 1977. The NMMSS data base contains data on U.S.-supplied international nuclear materials transactions, foreign contracts, import/export licenses, government-to-government approvals, and other DOE authorizations, such as authorizations to retransfer U.S.-supplied materials between foreign countries. The NMMSS also maintains and provides DOE with information on domestic production and

[2]A retransfer is the transport from one foreign country to another of nuclear materials previously exported from the United States or the materials produced through the use of nuclear materials previously exported by the United States.

[3]Special nuclear materials are plutonium, uranium-233, and uranium enriched above 0.711 percent by weight in the isotope uranium 235.

materials management, safeguards, physical accountability, financial and cost accounting, and other information related to nuclear materials. In addition, the NMMSS provides NRC with data on nuclear materials accountability and safeguards for NRC licensees.

U.S. Ability to Track Nuclear Materials Internationally Is Limited

The United States relies primarily on the NMMSS to track the nuclear materials that it exports to foreign countries. However, this system does not have all of the information needed to track the current location and status of all nuclear materials of U.S. origin that are supplied to foreign countries. The amounts, types, and reliability of the data contained in the NMMSS depend largely on data reported under the international agreements for cooperation, as well as on foreign countries' and on U.S. and foreign facilities' willingness to report complete and accurate data.

NMMSS Does Not Track the Current Status and Location of Exported Nuclear Materials

The NMMSS' international tracking capability is limited primarily because the agreements for cooperation do not require foreign countries to report data on the current locations of U.S.-supplied nuclear materials. For example, as we reported in 1982 and 1985,[4] the U.S. agreement for cooperation with the European Atomic Energy Community (EURATOM)[5] does not require most EURATOM countries to inform the United States of retransfers of U.S.-supplied materials from one EURATOM country to another EURATOM country, or to report alterations to U.S.-supplied nuclear materials in most of these countries.[6] In addition, none of the existing agreements for cooperation require foreign countries to report intracountry transfers of U.S.-supplied materials from one facility to another. Thus, the NMMSS may not contain correct and current data on either which EURATOM country has U.S.-supplied nuclear materials or at what specific facilities these materials are located.

The NMMSS' international tracking capability also is limited because the data base does not contain certain data on the current status (i.e., whether

[4]Obstacles to U.S. Ability to Control and Track Weapons-Grade Uranium Supplied Abroad (GAO/ID-82-21, Aug. 2, 1982) and The U.S. Nuclear Materials Information System Can Improve Service to Its User Agencies (GAO/NSIAD-85-28, Jan. 14, 1985).

[5]EURATOM is composed of 12 countries: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom. These countries are treated as a single entity for the purposes of trade in and transfer of nuclear materials to and from the United States.

[6]Although Portugal and Spain are members of EURATOM, according to a DOE official they are subject to agreements for cooperation with the United States that predate their joining EURATOM. Therefore, most of the reporting exceptions in the EURATOM agreement do not apply.

the materials are irradiated, unirradiated, fabricated, burned up, or reprocessed) of all U.S. nuclear materials that have been exported to foreign countries, with the exception of Sweden, Australia, and Canada. The NMMSS contains status data about U.S.-supplied nuclear materials in these three countries because the United States performs annual reconciliations with them.[7] The reconciliations compare the NMMSS' data to the foreign countries' records. The NMMSS' data are then adjusted, where necessary, to reflect the current status of U.S.-supplied materials in those countries. However, for foreign countries that do not participate in reconciliations with the United States, the NMMSS contains data only on the export transactions and on transactions requiring U.S. approval (such as retransfers of the nuclear materials) that occurred subsequent to the export, as required by the agreements for cooperation.

The United States has also started an initial nuclear materials reconciliation with Japan, which illustrates the potential for substantial differences between data recorded in the NMMSS and the current status of U.S.-supplied nuclear materials in a foreign country. According to the NMMSS' data, Japan produced approximately 20.3 metric tons of plutonium from U.S.-supplied nuclear materials between 1978 and 1992. However, Japanese records indicated that Japan produced about 58.7 metric tons of plutonium from U.S. nuclear materials during that period. The DOE official who is performing the reconciliation cited two primary reasons for this difference. First, Japan was required to report to the United States only the amount of plutonium retransferred to other countries for reprocessing; thus, plutonium produced but not sent to other countries for reprocessing was not reported to the United States. Second, the current U.S.-Japanese agreement requires Japan to report certain retransferred-plutonium transactions under a unique quarterly reporting arrangement. The NMMSS was not modified to reflect this unique reporting arrangement and therefore did not contain data on the amount of plutonium that Japan reprocessed from U.S.-supplied nuclear materials after July 17, 1988—the date of the new agreement. A DOE official stated that the NMMSS was recently modified to accept this reporting arrangement, and Martin Marietta has begun entering these data in the system.

Reliability of NMMSS' Data Contingent on Complete and Accurate Reporting

The reliability of the NMMSS' data is also contingent on the willingness of foreign countries and U.S. and foreign facilities to report complete and accurate data on nuclear materials imports, exports, and retransfers.

[7]Sweden, Canada, and Australia have been fully reconciled through 1987, 1991, and 1993, respectively. A DOE official stated that, except for minor unresolved differences, reconciliations performed for Sweden and Canada through 1992 also have been completed and the NMMSS' data have been updated.

Although the NMMSS users whom we interviewed, such as members of the NMMSS Steering Committee,[8] were generally or very satisfied with the accuracy and completeness of information from the NMMSS, DOE occasionally has found instances of incomplete reporting while reconciling nuclear materials transactions. For example, in 1990 a reconciliation of the NMMSS' data with a foreign country's records identified several transactions, such as retransfers of low-enriched uranium, that had not been reported to the United States. These transactions were subsequently entered into the NMMSS. However, because the NMMSS does not distinguish between normal transactions and those added during the reconciliation process, we could not determine how many other NMMSS entries were added as a result of reconciliations with foreign countries. A DOE official stated that many transactions may be added to the NMMSS during the initial reconciliation with a foreign country, but in later years such entries are infrequent.

The extent to which the NMMSS can provide data on nuclear materials is also affected by the accuracy and availability of historical records. We have previously reported on problems in this area. For example, in 1985 we reported numerous errors in the international data contained in the NMMSS.[9] These errors resulted from inaccurate data entries as well as from missing documents of some historical transactions. A DOE official told us that DOE attempted to upgrade the accuracy of the NMMSS' international data by searching for old records documenting historical transactions. This official stated that the current NMMSS data base contains the best available data on historical transactions, given the limitations of these records. Some NMMSS users also told us that although older NMMSS data are sometimes inaccurate, they are the best data available.

DOE Used Poor Systems Development Practices in Modernizing NMMSS

Because the NMMSS was an older system, DOE decided to replace and modernize it. However, DOE decided to merely replicate the functions of the current NMMSS, and therefore its limitations will remain. In addition, DOE did not adequately plan the development effort for the new NMMSS. For instance, DOE did not identify and define users' needs or adequately explore design alternatives that would best achieve these needs in the most economic fashion. DOE could have reduced the likelihood that these

[8]The Steering Committee is a NMMSS user group composed of representatives from each of DOE's operations and naval reactor offices, the Office of the Chief Financial Officer, the Office of Arms Control and Nonproliferation, the Office of Weapons and Materials Planning, the Office of Safeguards and Security, and NRC's Office of Nuclear Material Safety and Safeguards and Office of International Programs.

[9]GAO/NSIAD-85-28, Jan. 14, 1985.

planning deficiencies would occur by following the software development requirements set forth in its own software management order.

DOE's Modernized NMMSS Will Replicate Current System's Functions

Martin Marietta's NMMSS is housed on a mainframe using unstructured COBOL code. Performing modifications on the NMMSS and designing custom reports is difficult because of the volume and complexity of the code. As a result, DOE believed that the NMMSS' operating costs could be reduced by modernizing the system's hardware and software. In addition, NRC supported DOE's decision to modernize the NMMSS' hardware and software because it believed that the replacement NMMSS would be less costly than Martin Marietta's existing system. Accordingly, DOE's Office of Arms Control and Nonproliferation tasked the Lawrence Livermore National Laboratory with developing a new NMMSS data base that would replicate the functions of Martin Marietta's NMMSS. Livermore hired a subcontractor to perform this task. Livermore's subcontractor wrote new software, developed a PC-based data base, and will operate the new NMMSS at its facility.

DOE Did Not Determine Users' Requirements

In planning for the development of the new NMMSS, DOE did not analyze the users' requirements. Such an analysis documents the organization's functional and informational needs, the current system and its effectiveness, and the organization's future needs. Such information is important because the more knowledge that is generated about potential system users and their operational needs, the more likely it is that the resulting system will meet the users' needs. In addition, identifying users' needs at the beginning of a development effort can help to reduce the need for later systems modifications, which are typically more expensive, and to eliminate the need for separate development efforts. Since the NMMSS' primary functions were developed during the late 1960s (for DOE facilities) and 1970s (for international reporting), it was particularly important that DOE, before the subcontractor's development effort, determine whether the NMMSS was meeting users' needs in the most effective manner, or whether changes in the design of the data base were needed to better serve its users.

DOE could have assessed users' needs by involving the NMMSS Steering Committee, which is composed of the major NMMSS users, in the new NMMSS planning process. Although the NMMSS Steering Committee is charged with reviewing and commenting on significant proposed changes to the NMMSS, it was not consulted about the conversion from Martin Marietta's NMMSS to

the subcontractor's new NMMSS. Most of the Steering Committee members were unaware that DOE was even considering a new system until months after the decision to develop a new NMMSS was initiated. Some Steering Committee members told us they felt that they were deliberately kept in the dark about the new NMMSS. For example, one Steering Committee member said he believed written notification of the new NMMSS was not provided because DOE headquarters did not want to give users the opportunity to raise any objections to the program. Another member said the Committee members felt that they had been ignored and misled about the proposed changes in the NMMSS' operations. Furthermore, several Committee members and other NMMSS users wrote to DOE's Office of Nonproliferation and National Security to express dissatisfaction that no effort had been made to involve the Steering Committee in the departmental decision-making process.

In explaining why users' requirements were not assessed, DOE officials stated that since the new NMMSS data base will duplicate the existing NMMSS' functions, a requirements analysis was unnecessary. They stated that users will be consulted on future enhancements to the data base. However, such an approach can result in a data base that perpetuates system weaknesses and leads to inefficiencies. For example, the current NMMSS' financial module does not contain all of the inventory valuation data needed by DOE's Office of the Chief Financial Officer (CFO). Since the new NMMSS is replicating the current NMMSS' functions, it too will not contain these data. In addition, because the Office of the CFO was not aware that changes to the NMMSS were being considered, in August-September 1993 the Office of the CFO sponsored, and a programmer began developing, a new system to satisfy these needs. An official within the Office of the CFO told us that if the Office had known about the new NMMSS development effort, they would have considered working with the new NMMSS development team to enhance the NMMSS' financial module, rather than developing a separate new system.

DOE Did Not Adequately Consider System Alternatives

The purpose of an alternatives analysis is to compare and evaluate the costs and benefits of various alternatives for meeting users' requirements and to determine which alternative is most advantageous to the government. However, DOE did not perform such an analysis for the new NMMSS development effort. Instead, DOE's analysis was limited to a cost comparison of two alternatives: (1) to have Martin Marietta modernize the NMMSS or (2) to have the Livermore subcontractor provide a new NMMSS data base. Furthermore, this analysis did not assess the benefits of the two

alternatives and was not used to determine which alternative was most advantageous to the government because it was prepared after DOE had already chosen to implement the second alternative.

In addition, because the new NMMSS will simply replicate the current NMMSS' functions, it will be subject to the same nuclear materials tracking limitations that existed previously. Thus, the data contained in the new NMMSS on the status and location of U.S.-supplied nuclear materials internationally will continue to be limited by the data reported under the agreements for cooperation.

In addition, the comparison of costs for the two alternatives cited in the analysis was not supported by adequate documentation and did not appropriately consider all relevant costs to ensure that DOE chose the most cost-effective alternative. Moreover, DOE had already decided to authorize the subcontractor to begin building the new NMMSS before this analysis was prepared.

DOE's cost analysis compared the estimated development cost and fiscal years 1994, 1995, and 1996 operating costs of the subcontractor's new NMMSS data base with Martin Marietta's upgrade proposal for the NMMSS. However, the documentation provided to support this analysis was inadequate. Specifically, the only documentation offered in support of the new NMMSS was a one-page document provided by Livermore's subcontractor, which DOE did not independently verify.

The cost analysis was also inadequate because it (1) did not include costs to develop the new NMMSS incurred by Livermore's subcontractor before the analysis; (2) included fiscal year 1997 costs in Martin Marietta's alternative but not in the subcontractor's alternative; (3) did not reduce Martin Marietta's estimated costs by the amount of indirect costs[10] that will continue to be incurred by Martin Marietta (and paid by DOE) even if Martin Marietta no longer operates the NMMSS; and (4) included the NMMSS' operating costs during development in the estimate for Martin Marietta's alternative but did not include these costs in the subcontractor's estimate. DOE's cost comparison also did not take into account the considerable costs to transition from Martin Marietta's NMMSS to the new NMMSS data base housed at the Livermore subcontractor's location. Moreover, the analysis did not consider any costs that Livermore will incur managing and overseeing the subcontractor's development of the new NMMSS.

[10]Indirect costs refer to costs (such as administrative expenses) that cannot be identified with a specific project or activity and are allocated to these programs on the basis of a causal/beneficial relationship. Many of these costs will continue to be incurred and allocated to other DOE programs.

We analyzed the cost documentation that DOE provided, taking the above factors into consideration. Although we could not determine with certainty whether DOE chose the more cost-effective alternative, since some cost data were not available, our analysis did determine that any potential savings are, at best, questionable and that upgrading Martin Marietta's NMMSS may have been a more cost-effective option.

Because of the flaws in DOE's initial cost analysis, we asked DOE to provide us with a total life cycle cost for the new NMMSS. As of November 21, 1994, DOE could not provide us with this information.

DOE Did Not Follow Its Own Software Management Order

Many of the new NMMSS' planning deficiencies could possibly have been avoided if DOE's Office of Information Resource Management Policy, Plans, and Oversight had been involved in the development effort. DOE's Computer Software Management order (DOE 1330.1D) requires that this Office approve or disapprove all administrative or manufacturing-oriented software acquisition or development efforts that will have an external impact.[11] An official in the Office of Information Resource Management Policy, Plans, and Oversight told us that both the current NMMSS and the new NMMSS fall under the software categories covered by this order. Another official in this Office stated that adequate requirements and alternatives analyses (including the costs and benefits of alternatives) are required before approval is granted. However, the Office of Arms Control and Nonproliferation neither sought nor received such approval for the new NMMSS development effort. DOE's Program Manager told us that he believed the DOE order did not apply because the new NMMSS was duplicating an already existing system. However, the order does not exclude software development efforts that duplicate existing systems.

Other U.S. Mechanisms to Track Nuclear Materials Have Limitations

According to DOE, the NMMSS was not intended or designed to track foreign countries' nuclear materials that were never imported to the United States. Accordingly, since the new NMMSS is replicating the functions of Martin Marietta's NMMSS, the new system will also have this limitation. Recognizing that the NMMSS does not contain such data, and given the NMMSS' other data limitations, the United States relies on other sources to obtain information on nuclear materials of both U.S. and foreign origin that are located in foreign countries. For example, the United States has relied on DOE and other agencies to help determine the quantity, location,

[11]External impact occurs when a system requires input from, or output to, one or more organizations (such as NRC-licensed facilities) besides the one responsible for its implementation.

origin, and characteristics of commercial plutonium in noncommunist countries. DOE also uses data provided by intelligence sources and technology to support nuclear materials nonproliferation programs.

We did not assess the reliability of these information sources. However, according to the recent Rand study performed for the Under Secretary of the Department of Defense, no intelligence community can know of all of the major nuclear facilities and activities in certain countries.[12] For example, according to an official from the Arms Control and Disarmament Agency, U.S. intelligence sources lacked reliable information on North Korea and Iraq. The Director of DOE's International Safeguards Division told us that the need for an international nuclear materials tracking system is clear and that if the U.S. system for tracking materials had been more effective, the United States might have known more about Iraq's nuclear program before Desert Storm. DOE has initiated efforts to improve the United States' ability to track nuclear materials internationally. We are reporting to you classified information on these efforts and their limitations separately.

Physical Protection of Exported U.S.-Supplied Nuclear Materials Requires Foreign Countries' Cooperation

To ensure the physical protection of exported U.S.-supplied civilian-use nuclear materials, the United States relies on the protection systems in recipient countries, these countries' compliance with IAEA's guidelines, and U.S. evaluations of the adequacy of their physical protection systems (e.g., security devices and guards, etc.). Once the United States exports nuclear materials, it is the responsibility of the recipient country to adequately protect them. While no international organization is responsible for establishing or enforcing physical protection standards, IAEA has developed guidelines that are broadly supported by its member states. These guidelines include protection measures such as the use of physical barriers along the perimeters of protected areas. The United States uses these guidelines to help evaluate whether foreign countries' physical protection systems are adequate. As a result of these evaluations, the United States may make nonbinding physical protection recommendations.

The international community, including the United States, has supported states' sovereign rights and responsibilities to establish and operate physical protection systems for nuclear materials and facilities. It is also in the best interest of the sovereign states to ensure the physical protection

[12]Limiting the Spread of Weapon-Usable Fissile Materials, Rand National Defense Research Institute, 1993.

of these materials to reduce the threat of theft or diversion. Concerns have been expressed about the physical protection of U.S.-supplied nuclear materials at the High Flux Petten Reactor in the Netherlands. Reportedly, Dutch Marines staged a mock attack on the facility and gained access to its HEU. During this review, we visited the High Flux Petten Reactor and met with Dutch officials, who confirmed that this incident, which was intended to test the facility's physical security system, did occur. These officials also noted that physical security at the reactor has improved since the incident took place.

Although the ultimate responsibility for the protection of nuclear materials resides with the sovereign state, according to IAEA the protection of these materials is a matter of international concern and cooperation. Nevertheless, no international organization is currently responsible for establishing physical protection standards or ensuring that nuclear materials are adequately protected from unauthorized removal and that facilities are protected from sabotage. However, beginning in 1972, IAEA convened international experts to establish and subsequently revise guidelines on the physical protection of civilian-use nuclear materials. These guidelines represent a broad consensus among IAEA's member states on the requirements for physically protecting nuclear materials and facilities. IAEA also assists states that request guidance on physical protection by providing international physical protection experts as consultants. The United States supports these assistance efforts and provides experts when requested.

The United States also evaluates foreign countries' physical protection systems under the U.S. Bilateral Physical Protection Program. According to DOE, the primary objective of this program is to fulfill U.S. statutory obligations under the Atomic Energy Act of 1954, as amended by the Nuclear Non-Proliferation Act of 1978, and the provisions of specific U.S. agreements for cooperation. These obligations require that the United States ensure that U.S.-supplied nuclear materials are subject to a level of physical protection that meets or exceeds IAEA's guidelines. In addition, other objectives of this program are to (1) address emerging nuclear proliferation threats and problems, (2) promote technical exchanges and cooperation for physical protection, and (3) strengthen international cooperation and the implementation of treaties and agreements.

According to DOE, the countries participating in the U.S. Bilateral Physical Protection Program do so principally because they have or expect to have

- an agreement for peaceful nuclear cooperation with the United States, or a trilateral supply arrangement with IAEA and the United States;
- U.S.-supplied nuclear materials;
- category I quantities of nuclear materials;[13] and/or
- a pending U.S. nuclear export or supply arrangement.

U.S. teams are led by a DOE representative and usually include officials from other agencies.[14] The teams visit a variety of nuclear facilities, including research reactors, fuel cycle facilities, and nuclear power reactors. According to an NRC official, these visits have also been an important source of information when NRC assesses a country's physical protection system as part of the process of reviewing export license applications.

Since 1974, the United States has conducted bilateral consultations with approximately 46 nations, including site visits to review the physical protection of nuclear materials at fixed sites and during transport. (App. II identifies the countries that U.S. officials have visited.) More recently, program officials have started to explore possible technical cooperation and information exchanges with the newly formed states of the former Soviet Union and Eastern Europe.

According to DOE, the U.S. site visit teams will make nonbinding recommendations for improvements to physical protection when such improvements are needed. In cases in which countries have been revisited, efforts are made to follow up on the previous team's recommendations. However, according to a DOE official, DOE does not have a mechanism to follow up on previous recommendations in between visits and has not always monitored the status of the sites visited. He said that a mechanism to follow up on recommendations in between visits is important, since some countries may not be revisited for 4 to 5 years.

Conclusions

DOE's NMMSS has significant limitations in its ability to track nuclear materials internationally; these limitations will continue under DOE's new NMMSS. In particular, the new NMMSS will not overcome previously existing nuclear materials tracking limitations that are often caused by

[13]Category I nuclear materials represent certain types of unirradiated plutonium (2 kilograms or more), uranium-235 (5 kilograms or more), and uranium-233 (2 kilograms or more).

[14]This program is an interagency executive branch program implemented by the Departments of State, Energy, and Defense with the participation of the NRC and the Arms Control and Disarmament Agency.

non-system-related problems; for example, the system does not contain data that are not required to be reported under the U.S. agreements for cooperation. We believe DOE should have explored systems alternatives and queried its intended users to attempt to mitigate some of these limitations. In addition, because DOE has not followed good systems development practices, DOE cannot ensure that the system will be cost-effective or will even fulfill the needs of its major users.

Recommendation

Before investing further resources in the new NMMSS, we recommend that the Secretary of Energy direct the Office of Arms Control and Nonproliferation to determine users' requirements, investigate alternatives, conduct cost-benefit analyses, and develop a plan to meet any identified needs, either through enhancing the new NMMSS or designing a different system.

Agency Comments and GAO's Response

We discussed the contents of this report with the Director of DOE's Office of Export Controls and International Safeguards, officials in the State Department's Office of Nuclear Energy Affairs, and the Director of NRC's Division of Nonproliferation, Exports, and Multilateral Relations. However, as requested, we did not obtain written agency comments on a draft of this report. The DOE, State Department, and NRC officials that we spoke with generally agreed with the facts presented. DOE also provided the following comments, which we evaluated.

DOE officials commented that the NMMSS' size and complexity and its role in meeting U.S. treaty and statutory obligations led DOE to focus initially on duplicating NMMSS' functions and not on upgrading the system; such an upgrade will be considered after the duplication effort has been successfully accomplished. We believe that the size and complexity of the NMMSS and its pivotal role in meeting U.S. treaty and statutory obligations should have compelled DOE to ensure that the system was planned and designed properly. As we point out in the report, DOE's decision to duplicate the existing NMMSS' functionality led to a system that may not meet users' needs and that perpetuates the existing system's weaknesses. Furthermore, program modifications to upgrade systems at a later time are typically more costly and more risky than initially programming the system to meet users' needs.

Our work was performed between October 1993 and November 1994, in accordance with generally accepted government auditing standards. Appendix III describes the scope and methodology of our review.

As agreed with your offices, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies of the report to appropriate congressional committees; the Secretaries of Energy and State; and the Chairman, Nuclear Regulatory Commission. We will make copies available to others upon request.

Please call us at (202) 512-3841 and (202) 512-6222, respectively, if you or your staff have any questions. Major contributors to this report are listed in appendix IV.

Victor S. Rezendes
Director, Energy and Science Issues
Resources, Community, and Economic Development
Division

Joel C. Willemssen
Director, IRM-Resources, Community,
and Economic Development
Accounting and Information Management
Division

Contents

Figures

Abbreviations

CFO	Chief Financial Officer
DOE	Department of Energy
EURATOM	European Atomic Energy Community
GAO	General Accounting Office
HEU	highly enriched uranium
IAEA	International Atomic Energy Agency
NMMSS	Nuclear Materials Management and Safeguards System
NRC	Nuclear Regulatory Commission

Nuclear Materials Export Processes

The United States regulates its exports of U.S.-supplied nuclear materials to countries with U.S. agreements for cooperation through the implementation of the U.S. nuclear materials export license process. The Nuclear Regulatory Commission (NRC) is responsible for issuing export licenses for nuclear materials. In accordance with the Nuclear Nonproliferation Act of 1978 and the Department of Energy's (DOE) regulations, the executive branch agencies (DOE, the Departments of Commerce, Defense, and State and the Arms Control and Disarmament Agency), led by the Department of State, assist NRC in reviewing export license applications in certain cases. NRC generally grants export licenses if the following criteria are met:

- The International Atomic Energy Agency's (IAEA) safeguards will be applied pursuant to the Treaty on the Nonproliferation of Nuclear Weapons[15] and the Treaty of Tlatelolco.[16]
- No material will be used for a nuclear explosive device or for research on or the development of a nuclear explosive.
- Adequate physical protection measures will be maintained for facilities and materials.
- No material will be retransferred[17] without U.S. consent.
- The exported material will not seriously prejudice U.S. nonproliferation objectives or jeopardize the common defense and security.
- No material will be reprocessed or altered in form or content without previous approval from the United States.
- Material will be under the terms of the agreement for cooperation.

As figure I.1 outlines, to apply for a license to export special nuclear materials, an application must be submitted to NRC. NRC checks the application for completeness and accuracy and determines if an executive branch review (DOE, the Departments of Commerce, Defense, and State and the Arms Control and Disarmament Agency) is required. Executive branch reviews are necessary if, among other things, the export is (1) more than 1 effective kilogram of highly enriched uranium or 10 grams of plutonium or U-233 or (2) if source materials (uranium, thorium, or any

[15]Under the Treaty on the Non-Proliferation of Nuclear Weapons, signatory nonnuclear-weapons states that had not manufactured or detonated a nuclear device before January 1, 1967, agree not to acquire nuclear weapons and to accept IAEA's safeguards on all source and special nuclear materials in peaceful nuclear activities.

[16]The Treaty of Tlatelolco prohibits nuclear weapons in signatory Latin American countries and requires commitments to IAEA's safeguards.

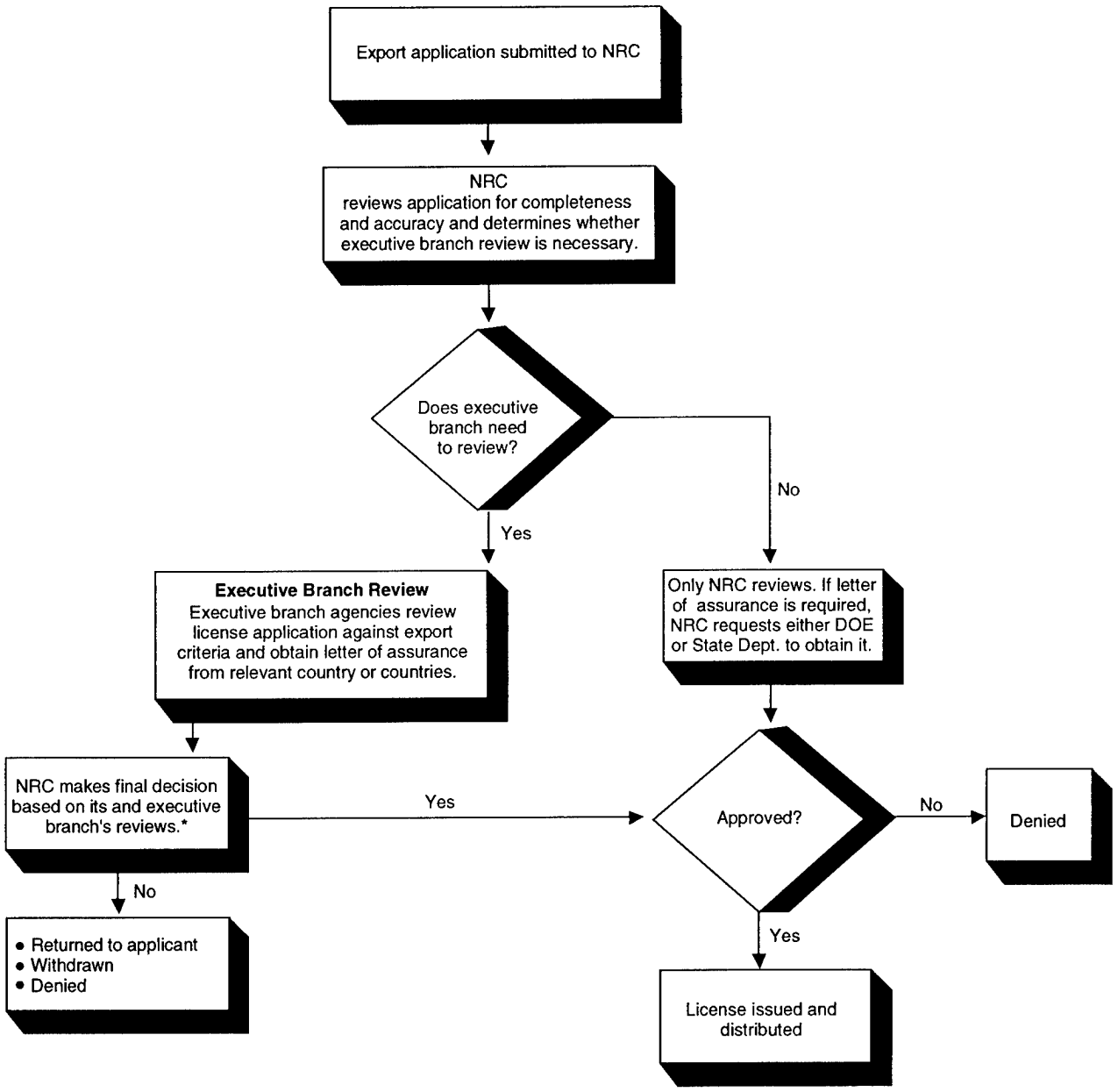
[17]A retransfer is the transport from one foreign country to another of nuclear materials previously exported from the United States or the materials produced through the use of nuclear materials previously exported by the United States.

ores containing uranium or thorium) or special nuclear materials are to be exported under the U.S.-IAEA Agreement for Cooperation. The executive branch review determines if

- the export request meets U.S. export criteria;
- the proposed export would not be inimical to the common defense and security of the United States; and
- where available, the exported materials would be under the terms of an agreement for cooperation.

NRC may request the executive branch to address specific concerns and to provide additional data and recommendations. If the executive branch and NRC determine that the request satisfies the above criteria, NRC will approve the export license. The export license establishes the amount of material that the applicant may export and the time frame in which that amount may be exported. The applicant may make multiple shipments of the material to reach the specified amount on the license.

Figure I.1: Interagency Review of Applications for Nuclear Materials Export Licenses



*NRC's Office of International Programs refers significant cases to the Commission (NRC) for review, as outlined in C. F. R. 110.40.

Note: If the executive branch review recommends denying an application, NRC must deny the application. However, if the executive branch approves an application but NRC denies it, the application is sent to the President for final determination based on the NNPA of 1978.

In 1993, the United States received 89 export license applications for nuclear materials (source, special nuclear material, and by-product[18]) of which 71 were issued in 1993 and 11 were subsequently issued by May 5, 1994. Of the remaining six applications, five are pending and one was withdrawn by the applicant country as of May 5, 1994. According to an NRC official, of the five pending applications, the United States is awaiting letters of assurance, as required, from the applicants before making a decision. A letter of assurance is a statement from the government of the recipient country that the nuclear materials will be handled in accordance with the terms set forth in the relevant U.S. agreement for cooperation.

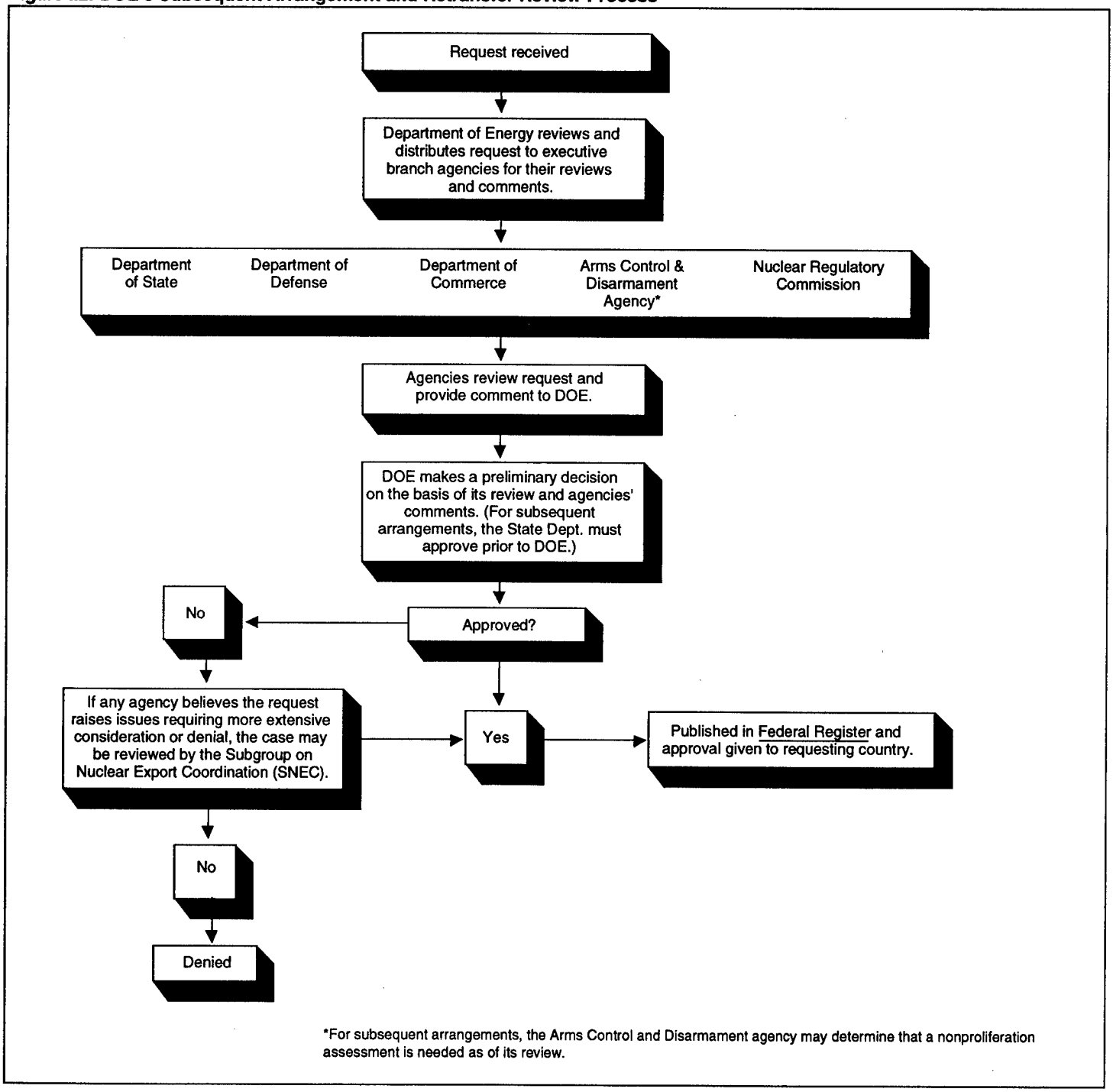
Once nuclear materials are exported from the United States, they are subject to the controls contained in cooperative arrangements established in the terms of U.S. agreements for cooperation. The subsequent arrangements and retransfer process are regulatory controls used to control the supply, use, or retransfer of exported U.S.-supplied nuclear materials and equipment. Activities that can be subject to subsequent arrangements are the reprocessing of spent fuel or the retransfer of nuclear materials to a third country. Generally, these requirements enable the United States to determine that the arrangement or retransfer will not be inimical to the common defense and security of the United States.

As figure I.2 outlines, DOE is generally the lead agency for processing subsequent arrangements and retransfer requests and coordinating the interagency review required for these requests. These interagency reviews provide the Departments of Commerce, Defense, and State and the Arms Control and Disarmament Agency and NRC the opportunity to review the request. For subsequent arrangements, the State Department must approve the arrangement in order for it to proceed, and the Arms Control and Disarmament Agency must determine whether or not the arrangement requires a nonproliferation assessment statement. After the interagency review, DOE will make a determination on the basis of its and the participating executive agencies' views. If, during the interagency review, any agency believes the request raises issues requiring more extensive consideration or denial, the request may be submitted for further discussion and concurrence to the Subgroup on Nuclear Export Coordination. This interagency group examines dual-use export issues, retransfers, and related matters to determine that the proposed activity is consistent with U.S. foreign policy, national security, and nonproliferation

[18]A by-product material means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation in the process of producing or utilizing special nuclear materials.

objectives and that commercial and economic considerations can be established.

Figure I.2: DOE's Subsequent Arrangement and Retransfer Review Process



U.S. Bilateral Physical Protection Visits (1974-94)

Country	Number of visits	Date of last visit
Argentina	3	1990
Australia	3	1991
Austria	2	1989
Belgium	3	1988
Brazil	2	1990
Bulgaria	1	1993
Canada	3	1989
Columbia	2	1994
Czechoslovakia	1	1992
Denmark	4	1990
Finland	1	1976
France	5	1992
Germany	4	1992
Greece	3	1993
Hungary	1	1992
India	1	1975
Indonesia	2	1991
Ireland	1	1976
Israel	1	1976
Italy	4	1988
Japan	6	1992
Luxembourg	1	1976
Malaysia	1	1977
Mexico	2	1990
Morocco	1	1993
Netherlands	4	1990
Norway	2	1984
Pakistan	1	1975
Paraguay	1	1977
Peru	2	1994
Philippines	2	1976
Portugal	2	1988
Rep. of Korea	3	1992
Romania	4	1993
Slovenia	1	1993
South Africa	2	1992
Spain	3	1988
Sweden	5	1990

(continued)

Country	Number of visits	Date of last visit
Switzerland	6	1993
Thailand	2	1977
Taiwan	1	1975
Turkey	1	1975
United Kingdom	3	1991
Uruguay	1	1977
Venezuela	1	1977
Yugoslavia	2	1989

Source: DOE.

Scope and Methodology

To determine the tracking limitations of DOE's Nuclear Materials Management and Safeguards System (NMMSS), we reviewed reports by NRC and DOE consultants and the U.S. agreements for cooperation. We also examined the NMMSS' documentation and other documents pertaining to the system and interviewed DOE, NRC, and Martin Marietta officials. While we did not interview a statistical representation of NMMSS users, we did interview members of the NMMSS Steering Committee and other major users to obtain their views on the accuracy and completeness of the NMMSS' data.

To assess DOE's new NMMSS, we interviewed DOE, Livermore, and Argonne National Laboratory program officials, NMMSS Steering Committee members, and other NMMSS users. We also reviewed the new NMMSS' planning documentation. We also spoke with officials with Livermore's subcontractor, reviewed the subcontracts, and reviewed the subcontractor's technical and cost proposals. In addition, we interviewed officials from the State Department, the Arms Control and Disarmament Agency, the Central Intelligence Agency, DOE's Pacific Northwest Laboratory, and the Department of Defense to determine whether other tracking systems exist.

To determine the U.S. process for evaluating the physical protection of foreign facilities, we interviewed officials from DOE, NRC, and the State Department. In addition, we also reviewed program documentation, including the results of U.S. site visits.

To understand the export license and subsequent arrangement process, we reviewed 10 C.F.R. Part 110 and interviewed DOE and NRC officials.

We performed our review primarily at DOE's headquarters at Washington, D.C., and Germantown, Maryland, locations; DOE's Lawrence Livermore National Laboratory, Livermore, California; Oak Ridge Operations Office and Y-12 Plant in Oak Ridge, Tennessee; Pacific Northwest Laboratory in Richland, Washington; and NRC's headquarters in Rockville, Maryland. We also visited the High Flux Petten Reactor in the Netherlands.

Major Contributors to This Report

Resources, Economic, and Community Development Division, Washington, D.C.	Jim Wells, Associate Director Gene Aloise, Assistant Director James C. Charlifue, Evaluator-in-Charge Mary Alice A. Hayward, Evaluator
Accounting and Information Management Division, Washington, D.C.	Valerie C. Melvin, Assistant Director Linda J. Lambert, Senior Auditor
Office of the General Counsel	John A. Carter, Senior Attorney